and a system of appointments is necessarily defective in so far as it does not insure the finding of the very best available man for the vacant position.

While a system of appointments calling for a national survey by specialists whenever an important position is to be filled would doubtless serve as a great incentive to the younger men, yet the main advantage would result from the fact that men of the greatest energy and ability would be placed in positions where they could work to the best advantage, instead of wasting the greater part of their energies while others are wasting most of their opportunities. It is a question calling for national action, since our system of inbreeding is so well intrenched and works to the advantage of so many persons of mediocre ability, that it is scarcely to be expected that the authorities would be willing to face the storm resulting from a decided change in a single institution.

The natural body to establish a bureau of information, if Professor Wenley's suggestion were to be adopted, would appear to be a national organization of men representing the department of inquiry. If the American Mathematical Society and the American Chemical Society, for instance, would appoint committees representing the various parts of the country, and entrust such committees with the nomination of the best possible men for the positions brought to their attention, they would doubtless render a most important service. As such a committee would feel the great responsibility of having their actions reviewed by a national society of experts, it would doubtless look into the matter much more carefully than individuals do, who are casually asked to express their opinions in regard to the best available men. It seems also likely that appointing bodies would generally be very eager to secure such expert advice and thus remove a part of the responsibility from their own shoulders.

Whether such a bureau of information would be as satisfactory as the Italian system, properly modified to meet our situation, it seems difficult to predict. At any rate, the present haphazard method seems so bad that it does not appear likely that any one resulting from a full discussion of the matter could fail to be far superior. It need scarcely be added that a wise system of appointments would be apt to check the tendency towards czarism on the part of our big institutions—a tendency which has alarmed many of our best men and threatens to serve as a barrier in securing the very best talent for university positions.

G. A. Miller

University of Illinois

On the Origin and Age of the Sedimentary Rocks

To the Editor of Science: In replying to Dr. Barrell's criticisms[1] I wish, first of all, to make it clear that I have no fault to find with the "detailed studies of the geological record"; the matter in dispute has to do with the *theories* which the geologists have founded on their interpretations of the observations.

Dr. Barrell states that I claim to have demonstrated that the earth was "protected by a cloud envelope until the Tertiary"; herein he disregards my published—qualified—statement that (in view of my results) Manson's hypothesis must now be modified; and the nature of this modification is clearly indicated by my references to "warmer" and "colder" months of the year as still existing at the very beginning of a glacial epoch; in other words, while I accept the theory that the former higher temperature of the ocean was necessary to supply the material for the (now disappearing) ice sheets, I find that climate then, as now, must still have been local, and there seem to be no good reasons why climate should not have been sensibly local in those earlier times for which we have records showing that living organisms then existed; only in the still earlier history of the earth was the cloud mantle so thick that the sun's influence was rendered practically insensible at the earth's surface.

But, considering the comparatively small size of the earth, this condition of things could exist through the hundreds of millions of

[1] Science, pp. 371–3.

years (which geologists claim were required for the formation of the rock layers containing evidences of former terrestrial life) only on the supposition that there was practically no radiation into space of inherent earth-heat; the assumption has been that the earth's surface temperature was kept from falling to a lower temperature because of the assumed high temperature of space (by "temperature of space" I mean the temperature of the solar rays in free space at the earth's distance from the sun).

But, as I have demonstrated that the temperature of space is far below the hitherto accepted value of this constant, the earth must be losing its heat with much greater rapidity than the advocates of a cooling earth have, theoretically, found to be the case for the data used. If, as most geologists claim, the stratified rocks were produced by a rearrangement of the matter previously contained in the older rocks, then, indeed, the hundreds of millions of years might easily be required to produce the rock strata built up since pre-Cambrian times; but, if the building material was obtained and transported in the manner here explained, the geological periods were of very much shorter duration.

To make a fairly comprehensive reply to Dr. Barrell's criticisms a very brief presentation of my theory as to the origin of the main sedimentary rocks will be necessary.

I find that geologists in their studies have regarded as unessential the part which the ancient volcanoes must have played in the formation of rock strata. Without in any way calling in question certain assigned effects produced by the action of water in its various forms and positions, it seems to me that the transporting power of the atmosphere must have been by far the most efficient agent for covering the earth's surface with different layers made up of finely divided matter which was originally ejected into the atmosphere in the form of volcanic dust, the chemical constitution of which varied from time to time and was further modified by contact with the atmosphere and water.

In a recent issue of SCIENCE I show, theoretically, that the eastward circulation of our atmosphere is caused by a vertical circulation (the ascending matter being arranged in the form of an expanding spiral having the greatest density near the axis of the spiral), resulting from ruptures of air strata in unstable equilibrium because of the different temperatures due to trapped heat. Now it is known that the gases issuing from certain volcanic vents are not only under very great pressure, but the temperature of these gases is very high, consequently the lighter materials also issuing from the vent will be carried to various great heights along with the expanding gases, and before these materials have time to settle back to the earth's surface differential angular drifts (diurnal) cause this matter to be distributed throughout a broad zone parallel to the equator and completely encircling the earth. Owing to the eastward circulation of the atmosphere, much more matter falls on the east side of the meridian of the vent than on the west side, as the heavier materials settle back to the earth sooner than the lighter ones. In general, therefore, the slope of the accumulated material will be long and gradual on the east side, but short and steep on the west side of a volcanic region. If the surface on which the débris falls is the ocean (or other body of water), most of the matter finally sinks to the bottom and forms stratified layers; but if water currents are present, a different distribution is made.[2] Wind and rain tend to keep the higher land areas swept clear of such matter, so that stratified layers do not, as a rule, accumulate on such a surface.

[2] As the weight of the deposit is much greater on the east side, the weak, severely strained crust on the west is often found dipping into the ocean; and local débris-transporting currents are formed by contact of the water with both the thin crust of the earth and with the heated matter forced into the bed of the ocean through newly-made faults or fractures. The greatest crustal heat is conveyed to the water at the greatest ocean depths; from this it follows that the greatest ocean currents should be formed among the volcanic islands.

According to this theory, then, in pre-Archean times when the crust of the earth had fallen to the temperature at which water would no longer boil, the water-vapor in the atmosphere began to condense to form the primitive ocean; tidal effects produced irregular distribution of crustal tension, causing fractures (most probably along meridian lines), of the solidified crust, thus allowing the seepage of surface-water and the consequent formation of the first volcanic vents. As a result of the constantly increasing weight of a given cone, the supporting crust in the immediate vicinity was depressed deeper and deeper below the general level (and still farther depressed through the additional weight of the now water-filled surrounding valley), causing a series of circular wave-like upthrusts separated by water-filled valleys of decreasing depths as the distance from the vent increased. The linear series of vents, along the line of fracture, through continuous growth finally formed a central serrated ridge bounded on each side by a series of parallel ridges of decreasing height. The eastward motion of the atmosphere caused the valleys on the east side to be filled much more rapidly than those on the west side, and thus produced the conditions favorable for the formation of a continental surface sloping to the east, from the volcanic ridge.[3]

About Archean times the decreased surface temperature—the changed topography of the rock surface (due to the unequal distribution of the volcanic débris, thus causing differential uplifts), and the consequent partial removal of the cloud envelope in certain regions—made possible the advent of other forms of matter, including living organisms.

As the thickness of the crust continued to increase—mostly through the addition of materials from the earth's interior—the number of the then existing vents gradually decreased, through the closing of the seepage channels by the volcanic débris. Later on, fresh fractures along neighboring lines of least surface strength resulted in the formation of new vents, and a new era of a dust-filled atmosphere, with its accompanying consequences, was again inaugurated.

As nearly all the material forming the layers deposited on the primitive crust was taken from the interior of the earth,[4] the accumulated warping of the crust towards the close of the period during which the sedimentary rocks were formed was very great —*much greater than could have resulted from shrinkage due to radiation of heat from the inside-out surface alone!*

If the erupted material for a given rock layer was laid down slowly, through long-continued activity, the evidences of former terrestrial life may be visible throughout the whole thickness of the rock formed; but if the deposition of matter was very rapid, all signs of former life may be wanting, and the total extinction of certain organisms may thus have resulted.

Some of these layers may have been deposited in the course of a few years, or even days, while for the formation of others, centuries may have been required.

With the removal of the lighter constituents of the earth's interior to the exterior surface, and the consequent strengthening of the crust, the number of active volcanoes rapidly diminished, thus practically closing the active period of sedimentary rock formation, leaving, in the main, only the ever-present secondary effects, resulting from surface erosion, to continue in operation.

By far the greatest result of these secondary causes is the topographic change produced by the two ice sheets of recent origin; these ice sheets, now mostly confined to the two arctic regions of the earth, but which only a few

[3] On the area between neighboring fractures extending in an east-west direction more débris was, of course, deposited—forming high table-lands—and the eastward extension of the slope became greater than was the case for fractures extending in a north-south direction. Long-continued local deviation from an eastward motion of the atmosphere caused a corresponding change in the direction of the local slope.

[4] During the past eighteen years I have published a number of short papers which favor the theory that the earth's surface is also continually receiving finely divided matter which has been ejected from the sun.

thousand years ago extended, in certain directions, well into the temperate zones, seem to offer positive evidence that the earth is growing colder. The theoretical (beautifully simple) explanation of the origin, growth and final retreat of the ice, which results from my modification of Manson's hypothesis, is, very briefly stated, as follows:

After the minimum polar-surface-temperature had fallen to 0° C. snow commenced to fall at the two poles during the respective winter months; each year this snow was, for some time, completely melted during the respective warmer seasons of the year; as the earth grew colder, the snow and ice covering became permanent and spread equatorwards with seasonal fluctuations at the ice front; but as the ocean grew colder the amount of evaporation from its surface decreased, so that the available amount of snow to be melted at the ice front continually diminished (while the intensity of the direct solar rays at the surface of the earth was, for a given latitude, continually on the increase);[5] a final retreat of the ice front was, therefore, inevitable. As the snowfall will later on cease altogether, the land ice will continue to retreat and probably disappear at the poles. These results are for ideal sea-level conditions; topographic irregularities, differences of elevation, direction of air and water currents—all act to produce great deviations from the theoretical results here made to depend on latitude and ocean temperature alone; these deviations have, in the past, been so great that evidences of former *local* glaciation should be found throughout nearly the whole series of stratified rocks.

In addition to the theoretical data given on page 415 of the current volume of SCIENCE, I would, in connection with Dr. Barrell's remarks on radiation of heat, call special attention to the fact that, since the publication of my paper demonstrating that Newton's law of radiation is theoretically exact, no less authority than Professor Newcomb has asserted (but not demonstrated) that Stefan's law of radiation has been established; now, as I claim to have demonstrated that "some surprising error in previous methods" has actually developed, Dr. Barrell or some other scientist must show that my demonstrations are erroneous before further intelligent use can be made of laws of radiation established by others and used (to quote from SCIENCE, February 14, 1908, p. 269) as "the formulæ accepted to-day" by scientists.

J. M. SCHAEBERLE

ANN ARBOR, MICH.,
September 29, 1908

[5] Because of this condition of things, it seems extremely probable that formerly, when the arctic climates were less severe, equatorial and temperate regions were for a time actually somewhat colder than they are to-day, for the lowering of the surface temperature resulting from the ever decreasing heat-trapping power of the atmosphere was, for a time, probably more than offset by the increased intensity of the direct solar rays.

CLOUDS OVER A FIRE

TO THE EDITOR OF SCIENCE: In connection with Mr. B. M. Varney's letter on "Clouds over a Fire" in SCIENCE for May 15, 1908, I may say that I have often observed the same phenomenon here. In cutting sugar cane the stalks are stripped of leaves in the field, and when the cutting of a field is finished the leaves are set afire as they lie spread over the field. When the weather is calm there arises a column of dark smoke which is often beautifully capped by a mass of white cloud. I have wondered whether the particles of smoke furnish nuclei for the formation of water drops as the smoke rises to a level of supersaturated air, or whether, as Mr. Varney suggests, the draft carries water vapor to a level of cloud formation.

WM. F. WALLIS

EWA, HAWAII

QUOTATIONS

DANIEL COIT GILMAN

DR. GILMAN was soon called from California to conduct what was, at its inception, a unique undertaking. This was nothing less than the establishment of a university for graduate study, with an equipment and faculty that should make it the rival of the best universities of Europe. On the disap-